

Magnetic properties of Thin-Films

Beamline: U5UA

Technique: Spin-Resolved Photoemission

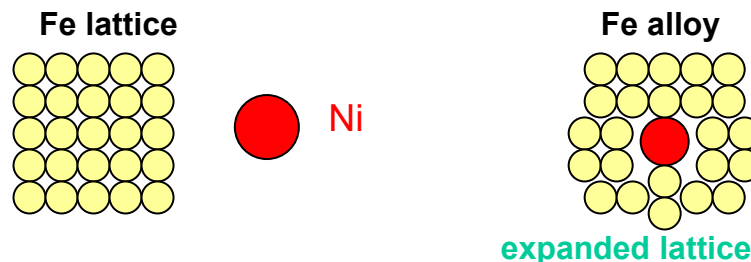
Researcher:
E. Vescovo (NSLS-BNL)

Publication:
E. Vescovo, et al. "U5UA: A New High-Resolution Undulator Beamline at the NSLS for Spin-Resolved Photoemission Spectroscopy", Synchr. Rad. News 12, 10 (1999);

I. Baek, H.-G. Lee, H.-J. Kim and E. Vescovo, "Spin Reorientation Transition in Fe(110) Thin Films: the Role of Surface Anisotropy", Phys. Rev. B67, 75401 (2003)

Thin films have different magnetic properties from their bulk counterparts. This is due to the artificial confinement of the electrons realized in the two-dimensional film geometry. For example ultra-thin films of Fe exposing the (110) surface order magnetically along the in plane (011) direction instead of the ordinary Fe easy-axis (the (100)-direction). Furthermore this behavior can be substantially modified by alloying in the pure Fe films small percentages of Ni. The Ni atoms, being larger, create a sort of internal chemical pressure which in turn induces a strong magnetoelastic anisotropy. This type of phenomenon is typical of what can be studied at the U5UA spin-resolved photoemission (SPPES) station. Here ultra-thin films are prepared *in-situ* under UHV conditions and their electronic structure is analyzed with angle-resolved photoemission. The measurement of the spin-polarization of the photoemitted electron provides direct information on the magnetic state of the film.

Chemical pressure Induces Magnetoelastic Anisotropy



Epitaxial FeNi(110) alloys films



W(110) single crystal substrate

Ni (%)	0 %	5 %	10 %
t_R (ML)	43	75	> 200

(Top row): partial substitution of Fe atoms with Ni, creates an expansion of the crystal lattice i.e.: an internal "chemical" pressure; (Middle row): the lattice expansion induces a strong magnetoelastic anisotropy which delays the critical reorientation thickness (t_R) at which the films reorients its magnetization. Quantitatively the effect is dramatic; values of t_R (in monolayers) vs. Ni concentration, as obtained from SPPES data, are displayed in the bottom table.